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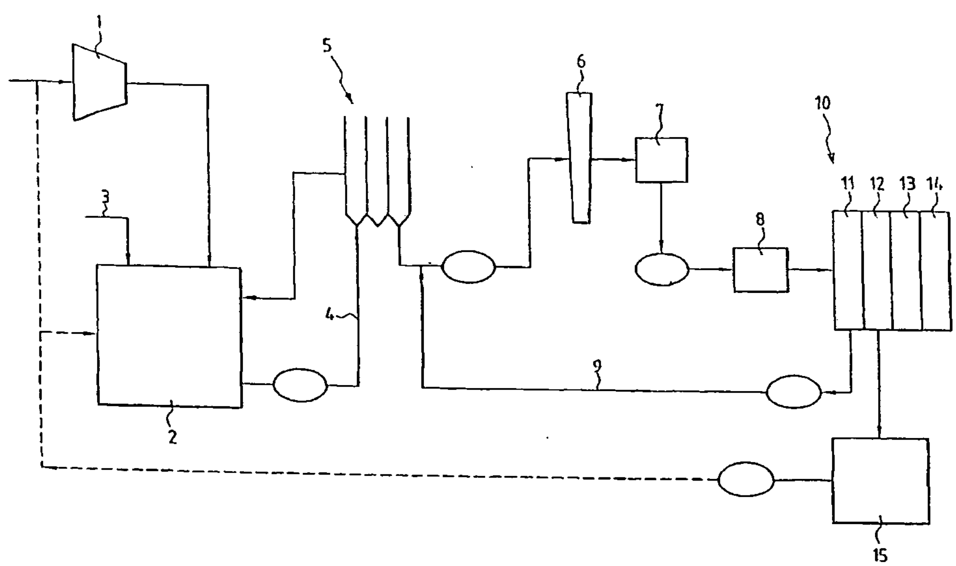
(54) Title: IMPROVEMENTS TO PROCESSES FOR MANUFACTURING PAPER PRODUCTS BY IMPROVING THE PHYSICO-CHEMICAL BEHAVIOUR OF THE PAPER STOCK



(57) **Abstract:** The subject of the present invention is a process for manufacturing paper from cellulose fibres dispersed in an aqueous medium, in which process carbon dioxide is injected into the stock directly or via an aqueous vehicle prior to an addition of chemical additives so as to control the ionic demand and the zeta potential downstream, and especially in the step of adding the additives. In particular, the additives are added to the mixing chest (2) and carbon dioxide is added to the white water on the output side of the brocke pulper (15) or to the short system (9).

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Improvements to processes for manufacturing paper products by improving the physico-chemical behaviour of the paper stock

The present invention relates to an improvement to paper manufacturing processes.

It relates more particularly to a process for manufacturing a paper product from paper pulp containing cellulose fibres dispersed in an aqueous medium, which pulp may come from various sources.

The terms "paper" and "paper product" are employed without distinction in the description. Without being restrictive, they may be: paper for graphical use, packaging paper, domestic paper, various special papers, together with board and the like, including also intermediate products of the dried cellulose pulp type.

The manufacture of paper products generally comprises several successive steps: firstly, the paper pulp is manufactured from various fibrous materials containing cellulose (wood and/or annual plants), water and chemical agents. This paper pulp - a suspension of fibres in water - is the starting product for further steps during which it is treated. The fibres dispersed in water are worked in order to obtain the desired paper characteristics of the final product - in particular, they are bleached, refined, washed and entangled. They are then dewatered and dried. During dewatering, the fibres have the property of naturally adhering to one another, thus forming a fibrous mat.

During manufacture, it is also possible to fix various non-fibrous materials to the fibres, such as fillers, dyes, starches and other auxiliary products. These various additives may be added to the fibre suspension before dewatering - they will thus be present in the

fibrous mat; they may also be added by depositing them on the surface of the web of paper after the dewatering step. This incorporation of chemical additives to the fibrous mat and/or to the web has the purpose of giving the final product particular properties specific to its use; mention may be made of sizing agents, dewatering and retention agents, starches, fillers, dyes, antifoams, wet-strength or WS agents, etc.

The invention applies broadly to the various processes for manufacturing paper products, and especially to those in which one or more of the aqueous vehicles is completely or partially recycled within the papermaking plant where they circulate in closed or semi-closed systems, as well as to those in which broke is incorporated.

The term "broke" refers to the paper waste arising from the process, especially that recovered during formation of the web of paper, for example coming from web breaks or web edge trimmings; papers from various sources, coated or uncoated papers coming from one or more paper machines, and paper waste from various sources may thus be found therein. Before being reincorporated into the paper system, the broke is treated in a particular system called the broke system.

The term "semi-closed (or semi-open) system" refers to any system in which a portion of the circulating aqueous vehicle is recycled; the term "closed system" refers to any system in which all of the aqueous vehicle flowing therein is recycled - only make-up water is added in order to compensate for evaporation.

The term "aqueous vehicle" itself denotes any aqueous medium and especially the dilution water, cellulose stock when its water content is such that it behaves as a fluid (consistency of around 15% of fibres by weight or less), effluents arising from the papermaking

process, or any other aqueous fluid circulating in its systems.

There are many systems within a plant for manufacturing paper products and they give rise to recycling of all or some of the aqueous vehicles circulating therein. Among these systems, mention may be made of: 1) the short or primary system, the paper pulp therein being in particular diluted and cleaned before entering the paper machine in order to dewatered and then dried; 2) the secondary system which collects the white water and distributes it to the dilution operations. This is because, for dilution, it is in particular the white water that is used, that is to say the recovered water arising from the dewatering the stock in the first part of the paper machine, called the wet end. This white water conventionally represents at least 80% and preferably at least 90% by volume of the dilution water; the balance consists especially of other process water and/or fresh water. In the description that follows, the terms "white water" and "dilution water" are used without distinction; the context allows a person skilled in the art to know, without any ambiguity, the meaning to be ascribed to this term when a distinction proves to be necessary.

It is known that paper machines whose operating rates have increased considerably in recent years are subject to perturbations. These perturbations may be of mechanical, hydraulic, but also chemical, origin; they result in malfunctions within the machine, possibly resulting in the web breaking and therefore in the machine being shut down, and in general in excessive consumption of additives. This entails a substantial increase in the treatment and maintenance costs due in particular to the fouling of the exchangers, forming fabrics, felts, vacuum pumps and other components of the paper machine.

As mentioned above, some of these problems are chemical in origin. They stem in particular from the fact that, during manufacture of the paper, many mixtures of pulps coming from various sources are produced: virgin pulps and manufacturing broke, chemical pulps and mechanical pulps, in particular virgin pulps and recycled pulps. These pulps of various origins have different characteristics, especially as regards the nature and the amount of additives, such as those mentioned above, these possessing their own physico-chemical characteristics (particularly pH and ionic potential).

The re-circulation of the aqueous vehicles in the semi-closed or closed systems of papermaking plants is becoming increasingly important at the present time, this recirculation involving the presence of large amounts of dissolved ions. To reduce the consumption of water considerably, it is becoming increasingly common to recycle the dilution water which results in an enrichment of the aqueous vehicles in terms of dissolved species and of colloids arising from the additives involved. The variety of cellulose pulps used in any one process further accentuates the problem.

It is known that the behaviour of the various constituents of the paper pulp depends in particular on the electrical charges carried by the species present, namely charged species and fibres present in the medium. The presence in an excessive amount of these electrically charged species impairs the proper running of the process - it is therefore essential, in order to improve the operation of the paper process, and especially the retention of the additives and the formation of the web, to control the behaviour of all of these electrical charges.

In seeking to improve the behaviour of the web on the paper machine and the retention of the additives in order thereby to even eliminate, or at the very least

reduce the rate of, web breakages, machine breakdowns and excessive consumption of additives, a person skilled in the art is interested in the influence of the zeta potential of the fibres or charges and that of the ionic demand of the medium on the behaviour of the web on the paper machine.

The zeta potential, expressed in millivolts (mV), is an electrical characteristic of solid particles, fibres or fillers, present in the water of the paper stock; it is connected to the distribution of electrical charges on the surface of the particles in question. The zeta potential of the fibres is subject to variations due to the presence of the various ion-generating chemicals which, when added during the paper manufacture, have an influence on the distribution of charges present on their surface.

Although the zeta potential has an indubitable influence on the retention and drainage mechanisms, and therefore on the formation of the paper web, another parameter is also important, namely the ionic demand. The latter characterizes the charge on the particles present in solution. It is measured by titration using an electrolyte. A specific amount of a filtrate is neutralized by an electrolyte; at the neutralization point, the amount of electrolyte used represents the value of the ionic demand. For example, if five millilitres (5 ml) of cationic polyelectrolyte are required to neutralize the anionic demand essentially due to the anionic colloids better known by those skilled in the art by the term "anionic trash" of a specific amount of a filtrate, then the cationic demand is -5 ml.

The publication "*New approach for chemicals control from stock prep to wet end*" by Denaud, Olsson, Berger, Bley and Burkey, ATIP Conference, Grenoble, 9-11 October 2001 describes the combined use of ionic demand

and zeta potential to control the way in which the additives are added during the papermaking process. The measurements are especially made in line, so as to adapt the amount of additives to the actual requirements at the various points where they are incorporated, thereby preventing overdosing which would compromise the correct operation of the rest of the process.

It is known from Patent WO 99/54741 to continuously monitor the formation of the web of paper by measuring the zeta potential of the fibres of a fibrous dispersion and by adjusting the amount of chemical additives added depending on its measured value. More specifically, the process parameters of the paper machine are adjusted, in a first stage, so as to obtain a paper of the required quality. The zeta potential is then measured at various points in the process. The zeta potential profile thus determined is called the optimum zeta potential profile. During continuous production, the objective is therefore to maintain this optimum zeta potential profile. When the potential profile departs from this optimum profile, the process parameters, and especially the amount of chemical additives, are modified so as to approach the optimum profile as was determined.

However, the solutions of the prior art presented above consist of interventions for the purpose of tailoring the amount of additives to be added to a given value of the measured parameters. Thus, in the case of Patent WO 99/54741, the aim is to re-establish the predetermined optimum zeta potential, which results in further additions of certain additives. Combined with the increasing recycling of white water, this further addition of additives contributes to increasing the excess ions already present in the systems and to exacerbating the resulting problems. In the case of the Mutek/ATIP publication, the addition of additives is

associated with the measurement, but although this prevents overdosing, it does not, however, make it possible to reduce the amount of additives needed.

The object of the present invention is to act on the charged sites present in the stock, upstream of the points of introduction of the additives, by carrying out a pre-treatment of the aqueous medium by means of carbon dioxide.

The object of the present invention is thus 1) to reduce the amount of additives to be initially added and 2) to provide a means of acting on the zeta potential other than the *a posteriori* addition of chemical additives. Instead of remedying the degradation of the zeta potential of the fibre by the addition of additives in larger amounts, the invention consists in acting preventatively on the elements that are disturbing the overall electrochemical system of the assembly formed by the aqueous medium and the fibres, in such a way that the additives are fixed to the fibres instead of interacting with the ionic compounds present in the aqueous medium.

In order to ensure that the disturbing elements have no influence, or less influence, on the action of the additives on the fibre, the invention also consists in controlling the ionic demand of the medium.

In order to establish in the paper stock the conditions necessary for effective action of the additives, whatever the composition of the stock, the aim of the invention is to supply the stream of stock with carbon dioxide, and to do so prior to incorporation of the additives. This supply of carbon dioxide may be accomplished by direct injection into the stream of stock, or by indirect injection via an aqueous vehicle that will feed into this stream. The carbon dioxide thus added modifies the physico-chemical behaviour of

the fibre-filler/aqueous medium assembly. In particular, it has been found surprisingly that, when carbon dioxide is injected into the paper stock upstream of the points of addition of the additives, a change in the ionic demand with respect to that in the absence of carbon dioxide is induced. This change in behaviour is manifested in particular by the stabilization of this demand on all of the aqueous vehicles treated with carbon dioxide, whether directly or indirectly. For example, the medium behaves as if the amount of anionic trash available were reduced, thereby allowing the cationic additives to be preferentially fixed to the fibre during their incorporation.

High retention is of paramount importance when manufacturing paper. This retention decreases significantly if there are too many charges in the white water. The colloidal charges stabilize the medium but excess charges weaken the flocculation, thereby resulting in lower retention or incurring an overdosage of retention agents.

According to one of its essential features, the process according to the invention is a process for manufacturing a paper product from a paper stock containing cellulose fibres dispersed in an aqueous medium, which process comprises:

- at least one step of adding chemical additives;
- a step of forming the paper product from the stock by mechanical separation of the fibres from the aqueous medium in order to form a fibrous mat; and
- at least one step of injecting carbon dioxide into the paper stock,

characterized in that at least carbon dioxide is injected into the stock upstream of at least one step of adding chemical additives so as to control the ionic demand of the aqueous medium downstream of the carbon dioxide injection point.

When the additives, generally cationic additives, are added to the paper stock in the presence of dissolved ions, and especially of anionic trash, they are not fixed, or are fixed in fewer numbers, to the fibres because the anionic trash interferes with their action - there is competition between the anionic sites of the fibres and of the medium. The carbon dioxide injected upstream of the point of addition of the additives acts on the anionic trash, not only at the point of carbon dioxide injection but also in all the communicating systems. This is manifested by a less negative and more stable cationic demand of the system when the situation with and without addition of carbon dioxide is compared.

Preferably, the injection of carbon dioxide upstream of a step of adding chemical additives furthermore makes it possible to stabilize the zeta potential of the fibres at the step of adding the chemical additives. Thus, when the carbon dioxide is injected in sufficient amount to control the cationic demand, it is observed that until the ions in solution have reacted the measured zeta potential changes little. After the anionic trash has reacted, the auxiliaries act on the fibre - the zeta potential then changes.

Trials carried out have thus shown, by monitoring the cationic demand of the system and the zeta potential, that the addition of carbon dioxide to the aqueous vehicle allows the concentration of anionic trash responsible for the cationic demand of the system to be rapidly decreased. The action of the carbon dioxide on the anionic trash thus makes better use of the cationic auxiliaries, which essentially form the auxiliaries used. The use of auxiliaries is therefore optimized, this being especially the case with cationic starch. The roll of cationic starch is twofold, namely it reduces the cationic demand and it improves the

physical properties of the paper. The carbon dioxide added upstream will, for the same amount of starch, increase its effectiveness or, for equivalent paper properties, will reduce the amounts of starch needed and in this case reduce the cost.

The carbon dioxide may be injected at various points in the papermaking system, most particularly when mixtures of pulps are produced. Thus, advantageously, the stock stream(s) flowing in the paper manufacturing system is(are) at least partly supplied with aqueous vehicles circulating in the closed or semi-open systems forming part of the paper manufacturing system and carbon dioxide is injected into at least one aqueous vehicle feeding into at least one stream of stock. When carbon dioxide is injected at several points, greater stability of the cationic demand and of the zeta potential are also observed, thereby allowing the process to be better controlled.

Preferably, the process includes at least one step of diluting the pulp with dilution water containing white water removed from the fibrous mat during the step of forming the paper product and carbon dioxide is injected into the dilution water upstream of the dilution step.

Advantageously, chemical additives are added to the stock in the mixing chest upstream of the short system and carbon dioxide is injected into at least one stream of stock feeding into the mixing chest.

It should be noted that it is unnecessary for the implementation of the process for the carbon dioxide injection and additive addition steps to be consecutive, nor even close to one another, or for the aqueous vehicles involved during the various steps to be the same. All that is required is that a fraction of the stream of stock be treated, before the additives

are added, with carbon dioxide directly or via the dilution water in order for the process of the invention to be applied.

Preferably, the pulp obtained from broke enters the composition of the paper stock and carbon dioxide is injected into the broke system.

Very preferably, carbon dioxide is injected into the dilution water on the output side of the broke pulper and before refining.

Particularly advantageously, at least some of the carbon dioxide is injected into the dilution water used to dilute the pulp in the short system of the papermaking plant and/or directly into the diluted stock upstream of the paper machine. Thus, the stock entering the machine is treated as is the white water leaving the machine and the streams of stock into which it will be reincorporated.

It is thus possible, by one or more judicious injections of carbon dioxide into the short system, to optimize the action of the additives which are added to the stream of stock diluted by the treated white water or which are added subsequently on the machine.

Advantageously, at least some of the carbon dioxide is injected into an effluent of the plant, to be treated, prior to the treatment, and, after the treatment, the effluent is reintroduced, at least partly, into a system of the paper manufacturing plant. This treated effluent part reintroduced into the plant is generally in the form of dilution water, but it may also contain fibres recovered during treatment of the effluent and reincorporated into a stock stream.

According to one particularly preferred variant of the invention, the process is carried out by slaving the

carbon dioxide injection to the measurement of the zeta potential value and/or the ionic demand value. This measurement is preferably carried out continuously on the diluted stock.

The carbon dioxide may be injected in liquid form.

It may be injected in gaseous form, especially in the case of carbon dioxide injection into the short system.

It may be injected partially in liquid form and partially in gaseous form.

The amount of carbon dioxide injected may be from 0.5 to 15 kg of carbon dioxide per metric ton of paper product and preferably from 0.5 to 3 kg of carbon dioxide per metric ton of paper product.

There are many advantages associated with the use of the process of the invention - they stem in particular from the reduction in the amounts of additives that have to be used to give the paper the qualities required for its use; thus, it should be noted that the process of the invention makes it possible, among other advantages, to:

- limit the fouling of the felts and forming fabrics;
- limit the blocking and furring of the vacuum pumps, exchangers, etc.;
- reduce the presence of various deposits in the paper product;
- increase the level of fixed charges in the paper;
- decrease the corrosion of the production tools;
- decrease the number of machine breakages;
- increase the productivity of the paper machine; and
- reduce the COD (chemical oxygen demand) of the system.

A better understanding of the invention will be gained from the illustrative examples that follow, these being given without any limitation, in conjunction with Figure 1.

Figure 1 indicates certain essential operations of the process for manufacturing a web of paper.

Thus, the pulp is refined in the refiner 1 and introduced into the mixing chest 2, in which various additional materials, including cationic additives and broke, if there is any, are also introduced at 3.

The stock coming from the mixing chest joins, via 4, the stock tank 5 where the stock is stored before being introduced into the short system. This short system conventionally, but not necessarily, comprises a purification step making use of one of the following devices or of equivalent devices:

- cyclone purification devices 6, generally of the cyclone washer type;
- devices 7 intended for removing the gas contained in the dilute stock in order to improve the homogeneity of the stock introduced into the head box of the paper machine, so as not to disturb the formation of the web; and
- a device 8 intended to carry out an additional purification step for the purpose of removing the last particles. This device is generally referred to as a "screen".

These three types of device form, together with the white water feed line 9 (a constituent element of the secondary system but considered here by extension as belonging to the short system), the elements of the short system in which the stock, prepared beforehand and possibly stored in the stock tank, is both purified

and suitably diluted before it is introduced into the paper machine 10.

The head element 11 of the paper machine, called the head box, delivers a ply of fibrous suspension identical over the width of a forming fabric. The free water and the fibres are then mechanically separated, the stock is dewatered and the web of paper is then formed by the deposition of the fibres, thus constituting the fibrous mat. The free water, drained away through the forming fabric by gravity and optionally with the aid of vacuum pumps, forms the white water. This is used in particular in the short system and in the broke system, but it is also transported via lines (not shown) of the secondary system to other semi-open systems of the papermaking plant.

On leaving the head box, the web penetrates the section 12 of the paper machine, called the press section, where the web is dried to a dryness of around 40%. It then leaves the wet end of the machine and enters the drying section 13 of the paper machine where the remaining water is removed by evaporation. At this point, the web reaches a dryness of greater than 90%, preferably greater than 95%.

The surface of the web is then treated by smoothing and calendering. Next, to improve the surface finish of the web, various elements, in particular fine pigments and adhesives contained in a composition called a coating slip, are deposited on the web. Of course, this coating operation is only carried out for certain paper applications, for example for the manufacture of papers intended for writing or printing. It is not necessarily carried out on the paper machine itself - it may be done away from the machine, after the smoothing operations.

When broke is recovered, it may be necessary to subject it to a treatment before it is reincorporated into the papermaking system; it may thus be repulped in a pulper 15, subjected to various purifying operations (not shown in the figure) and diluted by adding white water at various stages of the treatment, before it is stored and then reincorporated into the stock, especially in the mixing chest 2.

The examples of how the invention is implemented that follow illustrate its benefit; they were produced on industrial plants.

Example I:

The trial was carried out on bleached virgin pulp containing long and short fibres. Fillers consisting of natural calcium carbonate were added for the purpose of increasing the whiteness and the opacity of the paper.

Carbon dioxide was injected into the white water system 9 of the short system at the delivery pump of the white water recovery chest (not indicated in Figure 1); the amount of CO_2 introduced was 2.5 kg per metric ton of paper produced.

The cationic demand was measured (the measurement being taken on the filtrate by a Mutek apparatus of the "PCD" type) at various points without addition of carbon dioxide and with addition of carbon dioxide under the conditions indicated below. The results are expressed in ml.

The results are given in the table below.

Table 1

		Results without CO_2	Results with CO_2
Slusher (upstream of the process - not shown in the figure)	Cationic demand (ml)	-8	-9
Mixing chest 2	Cationic demand (ml)	-6	-8
Head box (of the paper machine)	Cationic demand (ml)	-4	-8

It may be seen that when highly cationic polymers are added:

- in the absence of carbon dioxide, the cationic demand tends to vary;
- when carbon dioxide is injected into the short system, this same demand remains constant. The ionic demand of the medium remains constant and is no longer disturbed by the addition of additives. The action of the latter is transferred to the fibres and not to the ions in the system.

Example II:

The following trial corresponded to virgin pulp composed of a mixture of short fibres and long fibres in a proportion of 50/50 into which WS (wet strength) type broke was incorporated. Carbon dioxide was injected into the stream of broke pulp before the mixing chest 2 and then also into the dilute stock in the short system before the head box 11.

The stream of broke represents approximately 20% of the total stream of stock.

The amounts of carbon dioxide were 5 and 3 kg per metric tonne of dry pulp, respectively. The additions

of cationic polymers of the WS agent type and starches are carried out in the mixing chest and at the mixing pump before the head box.

The following were measured:

- the cationic demand (the measurement being made on the filtrate by a "PCD" apparatus and the result expressed in ml) without addition of carbon dioxide and with addition of carbon dioxide under the conditions indicated above;
- the zeta potential of the cellulose fibre (the measurement being carried out by a "zetameter" type measurement apparatus and the result expressed in mV).

The results obtained are given in Table 2 below.

Table 2

	Parameters	Results without CO_2	Results with CO_2
Broke pulper	Zeta potential of the fibre (mV)	+22	-10
	Cationic demand (ml)	-1	+5
Pulp mixing chest	Zeta potential of the fibre (mV)	+150	+50
	Cationic demand of the filtrate (ml)	+100	+40
Short system	Zeta potential of the fibre (mV)	+100	+40
	Cationic demand of the filtrate (ml)	+50	+38

It may be seen that the addition of carbon dioxide to the various streams limits the variations in the ionic demand. The change in zeta potential is also less. This reduction in the fluctuations is essential for the papermaker, who thus has a more reliable system, thereby allowing him better dosing with the auxiliaries, while maintaining control of his process. He will thus make real savings in terms of auxiliaries.

The saving in auxiliaries of the cationic starch, dye and sizing agent type is around 15 to 20% depending on the type of pulp used and the type of paper produced. The fixing of the fillers added to the cellulose pulp is improved by 5%.

Better colour fastness of the paper is also observed. This is because when the zeta potential is positive, the pigment fixing is less effective; since the injection of carbon dioxide moderates the zeta potential, the pigments are fixed better.

Reducing the frequency of the paper web breaks on the machine results in a decrease in the number of stoppages of the machine of around 25%, and therefore a substantial improvement in the productivity of the paper machine.

CLAIMS

1. Process for manufacturing a paper product from a paper stock containing cellulose fibres dispersed in an aqueous medium, which process comprises:

- at least one step of adding chemical additives;
- a step of forming the paper product from the stock by mechanical separation of the fibres from the aqueous medium in order to form a fibrous mat; and
- at least one step of injecting carbon dioxide into the paper stock,

characterized in that carbon dioxide is injected at least at one point into the stock upstream of at least one step of adding chemical additives so as to control the ionic demand of the aqueous medium downstream of the carbon dioxide injection point.

2. Process according to Claim 1, characterized in that the injection of carbon dioxide upstream of a step of adding chemical additives furthermore makes it possible to stabilize the zeta potential of the fibres at the step of adding the chemical additives.

3. Process according to either of Claims 1 and 2, characterized in that the stock stream(s) flowing in the paper manufacturing system is(are) at least partly supplied with aqueous vehicles circulating in the closed or semi-open systems forming part of the paper manufacturing system and in that carbon dioxide is injected into at least one aqueous vehicle feeding into at least one stream of stock.

4. Process according to one of Claims 1 to 3, characterized in that it includes at least one step of diluting the pulp with dilution water containing white water removed from the fibrous mat during the step of forming the paper product and in that carbon dioxide is injected into the dilution water upstream of the dilution step.

5. Process according to one of Claims 1 to 4, characterized in that chemical additives are added to the stock in the mixing chest (2) upstream of the short system and in that carbon dioxide is injected into at least one stream of stock feeding into the mixing chest (2).

6. Process according to one of Claims 1 to 5, characterized in that the pulp obtained from broke enters the composition of the paper stock and in that carbon dioxide is injected into the broke system.

7. Process according to Claim 6, characterized in that carbon dioxide is injected into the dilution water after the broke pulper (15) and before refining.

8. Process according to one of Claims 4 to 7, characterized in that at least some of the carbon dioxide is injected into the dilution water used to dilute the pulp in the short system of the papermaking plant and/or directly into the diluted stock upstream of the paper machine.

9. Process according to one of Claims 1 to 8, characterized in that at least some of the carbon dioxide is injected into an effluent of the plant, to be treated, prior to the treatment, and in that, after treatment, the effluent is reintroduced, at least partly, into a system of the paper manufacturing plant.

10. Process according to one of Claims 1 to 9, characterized in that the process is carried out by slaving the carbon dioxide injection to the measurement of the zeta potential value and/or the ionic demand value.

11. Process according to one of Claims 1 to 10, characterized in that the carbon dioxide is injected in liquid form.

12. Process according to one of Claims 1 to 10, characterized in that the carbon dioxide is injected in gaseous form.

13. Process according to one of Claims 1 to 10, characterized in that the carbon dioxide is injected partially in liquid form and partially in gaseous form.

14. Process according to one of Claims 1 to 13, characterized in that from 0.5 to 15 kg of carbon dioxide per metric ton of paper product, and preferably from 0.5 to 3 kg of carbon dioxide per metric ton of paper product, are injected.

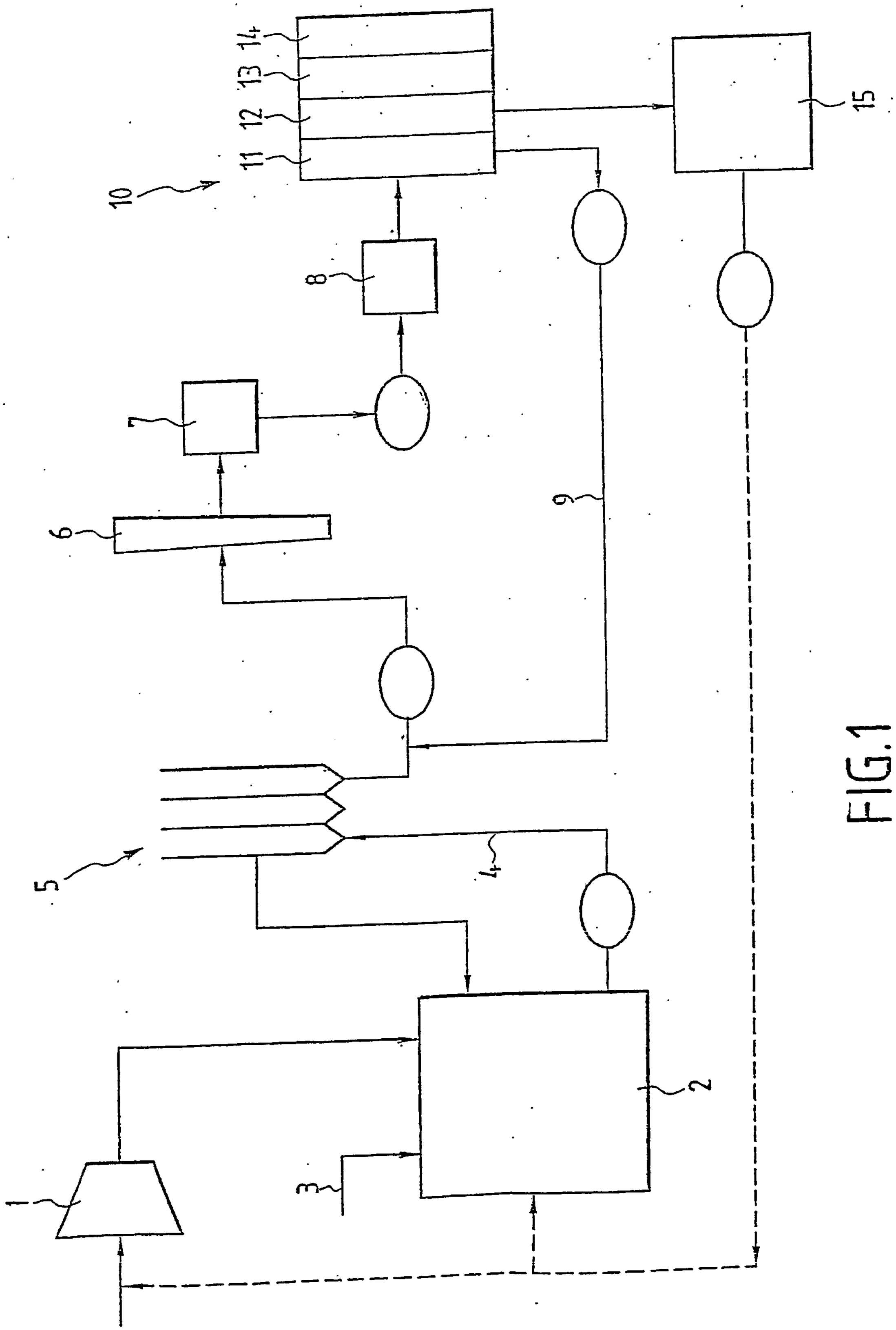

FIG.1

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(54) Title: IMPROVEMENTS TO PROCESSES FOR MANUFACTURING PAPER PRODUCTS BY IMPROVING THE PHYSICO-CHEMICAL BEHAVIOUR OF THE PAPER STOCK

(57) Abstract: The subject of the present invention is a process for manufacturing paper from cellulose fibres dispersed in an aqueous medium, in which process carbon dioxide is injected into the stock directly or via an aqueous vehicle prior to an addition of chemical additives so as to control the ionic demand and the zeta potential downstream, and especially in the step of adding the additives. In particular, the additives are added to the mixing chest (2) and carbon dioxide is added to the white water on the output side of the brocke pulper (15) or to the short system (9).

INTERNATIONA ƎEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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//D21H17:65

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 D21H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 884 416 A (PRAXAIR TECHNOLOGY INC) 16 December 1998 (1998-12-16) the whole document -----	1,6
X	EP 0 281 273 A (BOC GROUP INC) 7 September 1988 (1988-09-07) the whole document -----	1,12
A	WO 99 54741 A (HONEYWELL MEASUREX CORP) 28 October 1999 (1999-10-28) cited in the application -----	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
23 September 2003	02/10/2003

Name and mailing address of the ISA	Authorized officer
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